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B. T. GALLOWAY, Chief of Bureau.

WINTER WHEAT IN WESTERN SOUTH DAKOTA.

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WINTER WHEAT IN WESTERN SOUTH DAKOTA.

INTRODUCTION.

The value of winter wheat as a dry-land crop in western South Dakota has been the subject of much discussion during the past few years. The production of winter wheat in this area has not reached proportions of commercial importance. Wyoming and Montana, however, produced during the past season more than 7,250,000 bushels, and as the soil and climate of western South Dakota are very similar to those of the States mentioned there is good reason to believe that profitable returns may be obtained from the crop in this region.

The advantages in favor of winter wheat, where it can be successfully grown, are better distribution of labor by fall seeding and early harvest; early maturity, and therefore less danger from hail, hot winds, disease, etc.; greater drought resistance; and larger yields. Its importance as a dry-land crop is due largely to its early maturity and to its ability to produce a fair yield even in seasons of severe drought.

Winter wheat has been grown at several points in western South Dakota, in some instances for a number of years. While not uniformly successful, the crop promises good results when properly handled. The aim of this paper is to outline the best methods of growing this grain as shown by observation and by experiments that have been conducted. So little has been done, however, that it is not possible to say that any method is certainly the best. Yet it is thought that a summary of results obtained will be of value both in pointing out some of the mistakes most commonly made and in indicating the methods most likely to be successful.

DIFFICULTIES LIKELY TO BE ENCOUNTERED.

THE WINTERKILLING OF WHEAT.

Winterkilling is the injury most commonly feared in growing winter wheat and is the principal limiting factor in the northward extension of the winter-wheat belt. It is due to extreme cold, to exposure

and injury of the roots by the heaving of the soil, and to other causes. The extent of injury differs widely with the different varieties grown and is affected to a less extent by the preparation of the soil and seed and by the time, rate, and method of seeding.

During the three years in which tests have been conducted at the Bellefourche Experiment Farm,[1] situated near Newell, S. Dak., the winterkilling of the best varieties has seldom exceeded 25 per cent, while the average is less than 15 per cent. The stooling of these varieties has been such that the actual loss in bushels has probably been slight. At the present writing (Apr. 1, 1911), the fourth crop has come through the winter apparently in good condition.

It seems that a field may be greatly injured by winterkilling and yet produce a good yield, especially if the damage is evenly distributed throughout the field. Winterkilling of over 50 per cent at the Bellefourche Experiment Farm has in some cases been followed by yields of 20 bushels per acre and over.

The soil of the Bellefourche Experiment Farm is a heavy clay of the Pierre clay formation, commonly known as gumbo. Apparently it does not heave, and this fact has undoubtedly diminished the loss from winterkilling. On the other hand the winters have sometimes been severe and the plats have been so located that they received very little protection from snow.

THE BLOWING OF THE SOIL.

Damage from the blowing of the soil in high winds is an important consideration on the dry lands. The danger is greatest on soils containing sand or fine gravel and in fields fully exposed to the wind. In the late winter and early spring months, the velocity of the wind is often great enough to carry the soil particles rapidly across the field, cutting off the plants near the ground and exposing the roots to the weather. This condition is especially trying on dry farms, as dry winters are common and the plants and soil are left in a condition most favorable to rapid evaporation. Undoubtedly much of the loss ascribed to winterkilling may be traced to this cause.

The extent of injury likely to be done is affected by the location of the field, ridges being exposed to and valleys or swales being more or less protected from the full violence of the wind. Consequently fields partly protected are less likely to be damaged than are those fully exposed to the prevailing northwest winds.

Little progress has been made in devising methods of handling cultivated fields to prevent blowing. The problem is especially difficult for the dry-land farmer, as the fine soil mulch, which is so

[1] The Bellefourche Experiment Farm is in charge of the Office of Western Agricultural Extension of the Bureau of Plant Industry. The investigations reported in this circular were conducted in cooperation with that office.

necessary to conserve moisture, increases the danger from blowing. It is necessary, as far as possible, to choose some middle course which will involve the least loss of moisture and at the same time minimize this danger. Implements with cutting blades that fine the soil out of all proportion to the value of the work done should not be used. The disk and spring-tooth harrow are preferable, as they tend to bring the larger particles and lumps of dirt to the surface and allow the finer particles to reach lower levels of the soil stratum.

It is important that some method of crop rotation be followed that will supply humus to the soil, as possibly no other factor is so efficient in cementing the soil particles together and preventing blowing.

PREPARATION OF THE SOIL.

Several methods of preparing the soil for winter wheat have been advocated, such as seeding in small-grain stubble without previous preparation; seeding on corn ground between the standing rows with a 1-horse drill; seeding on corn ground after preparing with a disk and harrow; seeding on early fall plowing; and seeding on land prepared by summer-fallowing.

The first two methods are employed to catch and hold the snow and thus prevent winterkilling. The average snowfall in western South Dakota is rather light and the snow seldom stays on the ground during the entire winter. For this reason the benefit likely to be derived is not so great as in sections where the snowfall is heavier. On the other hand, there is apparently not as much danger from alternate thawing and freezing as in sections where there is more moisture, so that protection is not so necessary.

Possibly the chief difficulty likely to be encountered in growing this crop on any but summer-tilled land is to conserve sufficient moisture in the soil to germinate the grain and properly maintain its growth until the spring rains begin. The same difficulty also applies to summer fallow not properly cultivated or when the rainfall is so deficient that no moisture can be stored in the soil. The autumn precipitation is usually very light and so distributed that it is often insufficient to start the crop. It frequently happens that there is sufficient moisture to germinate the grain but not enough to maintain its growth, in which case it may be greatly injured or killed by continued drought. On the other hand summer tillage is likely to increase the danger from blowing, as the tilth necessary to conserve the moisture leaves the soil in such a condition that it is easily carried away by the wind.

The lack of experimental data makes it impossible to say just how essential is summer fallow in the production of winter wheat. The relative cost, yield, and chances of failure of grain grown on summer fallow and by other methods form a complex problem which will prob-

ably require several years to solve. Summer-fallowing is the method most widely advocated in Montana and western Nebraska and will apparently give the most satisfactory results in western South Dakota.

When heavy rains occur in the late summer and early autumn months, it may be found advisable to increase the winter-wheat acreage by seeding on corn ground or on early fall plowing. The former is probably preferable. In either case there should be sufficient moisture in the soil to keep the crop in good condition until spring. Otherwise, the plants may die or go into the winter in a weakened condition.

A good summer fallow consists essentially in early plowing and sufficient cultivation afterwards to conserve the moisture. A good plan is to plow in the spring as soon as possible after seeding, or earlier if desired. The ground may then be worked at once with disk and harrow, or it may be allowed to remain as left by the plow in the expectation of heavy rains in May and June. The method to be followed depends upon the quantity of moisture in the soil at the time of plowing. In either case cultivation should follow every rain sufficiently heavy to connect with the moisture below or to supply more moisture to the soil than will be lost by the cultivation. A practice sometimes advocated is that of plowing in the fall soon after the crop is removed and allowing the ground to remain rough until spring, when it is cultivated as in the former case.

No matter by what method winter wheat is grown, a firm seed bed is essential. This is, perhaps, one of the most important factors connected with the preparation of the soil, as upon it depend to a large extent the supply of available moisture and the germination and growth of the plant.

VARIETIES TO GROW.

The growing of varieties not adapted to the locality is a great drawback to the success of a crop. This fact has been clearly demonstrated by experiments conducted on the Great Plains and by the experience of farmers. Tests of the value of different varieties have been conducted for three years at the Bellefourche Experiment Farm, with the result that no wheat has been found superior to the Russian winter wheats, Kharkof and Turkey. Many other varieties from various parts of the United States and Canada have been grown in comparative tests, but practically all of them winterkilled entirely or to such an extent that very low yields were obtained. Only a few were at all promising. These results are so fully substantiated by tests conducted elsewhere that it would seem a waste of time and money to grow any but these varieties, except in an experimental way.

Home-grown seed or seed raised under conditions similar to those in this region should be used, as only in this way will the best results be obtained.

PREPARATION OF SEED.

The seed should be carefully cleaned and graded to remove all dirt, weed seeds, and small shrunken kernels. If smut is present the seed should be treated, as there is great loss from this parasite in seasons favorable for its development. One method is that of wetting the grain with a solution consisting of 1 pound of formalin to 40 or 50 gallons of water and then covering with a blanket or tarpaulin. The grain is allowed to remain covered for about two hours and is then spread out and occasionally stirred until dry, when it may be stored in a bin or in sacks free from smut. By this method, however, the smut balls are left in the grain and may break in the sacks in hauling or in the drill and thus infect the grain to some extent. If the grain is steeped in barrels or vats, or a good smut machine is used, the smut balls can be skimmed off and all infection prevented. The grain is sometimes sown without drying, in which case it is necessary to seed at a little heavier rate because of the swelling of the grain when wet.

TIME OF SEEDING.

The general belief is that winter wheat must be sown early in this section to obtain a good yield, the time usually considered best being from about August 15 to September 1. However, the results so far obtained at the Bellefourche Experiment Farm do not support this view.

In the fall of 1907 five plats of Turkey winter wheat were sown at intervals of about two weeks, beginning September 1. The highest yield (25.5 bushels per acre) was obtained from the plat seeded November 1. The plats sown October 1 and October 15 yielded nearly as much, but the one seeded September 15 yielded only 20.3 bushels per acre and that seeded September 1, 23 bushels. These plats were sown on new land broken during June, 1907, backset in August, and worked with a disk and harrow until a good seed bed was obtained. The test was continued in the same manner in the seasons of 1908–9 and 1909–10, except that the first plat was sown August 15 and the land was prepared by summer-fallowing. In 1909 the best yield (43 bushels per acre) was obtained from the seeding of October 1. The plats seeded August 15 and November 1, which were the earliest and latest seedings, respectively, yielded 5 bushels less, which was the lowest yield obtained.

In 1909 two plats were sown on each date at intervals of two weeks from August 15 to November 1. Those sown October 1 failed to come up because of cold weather soon after seeding, and some of the plats were injured by blowing. Of those harvested, the best average yields (19.3 bushels per acre in each case) were obtained from the plats seeded August 15 and September 15. The plat sown Septem-

ber 1 produced the lowest yield (8.3 bushels per acre), this low yield being due to the poor germination.

The above results show that a uniform rule can hardly be laid down as to the best date for seeding.

In every case a good stand in the fall has been followed by a good yield, except in one or two instances when the plats were injured by blowing. For this reason, it seems that the main effort should be directed toward obtaining a good stand rather than toward seeding at a certain date.

If a good seed bed is prepared and there is sufficient moisture present to germinate the grain and keep it growing vigorously, early seeding is advisable, as the temperature at an earlier date is likely to be more favorable to germination and rapid growth. It is not advisable, however, to seed on poorly prepared soil simply for the sake of seeding early, when a few days' delay would permit the preparation of a good seed bed. On the other hand, it is not well to put off seeding until very late, as there is grave danger that the seed will never come up.

It appears that to obtain a good yield a good stand is necessary, and a good stand depends upon the presence of certain conditions of moisture, temperature, and soil. These will vary in different seasons and in different localities, so that no rule that will apply in all cases can be given. Each farmer must study his own conditions and decide for himself what course to follow.

METHOD OF SEEDING.

It is essential that the seed be placed in close contact with soil containing moisture. To insure this it is best to seed with a drill, as by so doing the seed can be placed at the desired depth and the soil packed around it. By drilling, a more uniform stand is obtained and a smaller quantity of seed is required than by seeding broadcast.

RATE OF SEEDING.

The exceptional stooling of winter wheat makes it unnecessary and inadvisable to seed this grain as heavily as spring wheat. The usual rate recommended for semiarid conditions is about 3 pecks per acre, a less quantity sometimes being advocated. With a well-prepared seed bed this amount is probably sufficient for western South Dakota conditions. Unless damaged by winterkilling or other causes, winter wheat is more likely to be too thick than too thin at harvest time. While a very thick stand may slightly increase the yield in a favorable year, it may greatly decrease it in an unfavorable one.

TREATMENT AFTER SEEDING.

It is usually considered advisable to harrow winter grain lightly soon after it starts growth in the spring, for the purpose of conserving

the moisture. Whether the difference in yield will pay for the labor involved is an open question. More experimental data are required before it can definitely be stated when and under what conditions harrowing will be found beneficial. It will probably be of most value on soils likely to crust and in seasons when a heavy precipitation in the winter and early spring is followed by drought. On soils likely to blow, harrowing should not be done until this danger is past.

Where a field is badly damaged by winterkilling, good judgment should be exercised in deciding whether the crop should remain or the field be disked for spring grain. Undoubtedly many fields have been reseeded that would have made good yields had they been left in winter wheat. The ability of the Kharkof and Turkey wheats to recover is great, and, because of stooling, a uniform, thin stand in the spring will usually result in a good stand by harvest. The slowness of winter wheat to start growth in the spring after a hard winter is likely to mislead the farmer. In this connection it may be noted that clean land, free from weeds, is essential. Otherwise, after a severe winter the weeds may get the start of the wheat and greatly reduce the yield.

SUMMARY.

Where successfully grown, winter wheat possesses many advantages over spring wheat, such as better distribution of labor, earlier maturity, greater drought resistance, and larger yields. There is apparently no reason why it should not be grown successfully in western South Dakota.

The principal difficulties likely to be encountered are winterkilling and the blowing of the soil. The loss from winterkilling can be greatly reduced by growing the best varieties and by proper preparation of the seed and soil. Much damage from blowing can be prevented by selecting fields for winter wheat which, because of their location, are more or less protected from the wind. Implements which fine the soil more than necessary should not be used.

From the small amount of data available, it seems that summer-fallowing is probably the best method of preparing the soil for winter wheat. When other methods are used, the germination and growth of the wheat are uncertain because of the low average autumn rainfall. In seasons when the precipitation in the summer and early fall is heavy it may be advisable to increase the winter-wheat acreage by seeding on corn ground or on early fall plowing.

The general belief that winter wheat must be sown early is not supported by the results obtained at the Bellefourche Experiment Farm. It seems of much more importance to prepare a good seed bed, to use good varieties, and to sow when moisture, temperature, and soil conditions are best than to seed at any specified time. Early seeding is

advisable if a good seed bed is provided and there is sufficient moisture in the soil to germinate the grain and maintain it in good condition until spring.

Success with winter wheat depends very much upon the varieties grown. As far as known, the Kharkof and Turkey varieties are best for this region. Thin seeding is advisable. Three pecks of good seed per acre are probably sufficient.

Winter wheat should be sown with a drill, as in this way a better and more uniform stand is secured.

The Turkey and Kharkof varieties have great ability to recover after a hard winter. When damaged, good judgment should be exercised before reseeding to spring grain.

Approved:

JAMES WILSON,
Secretary of Agriculture.

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